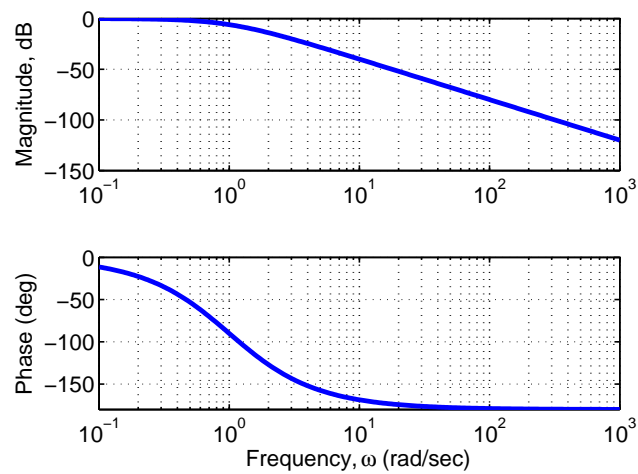


## 16.06 Principles of Automatic Control Recitation 8

Given  $G(s) = \frac{1}{(s+1)^2}$ , design a PD controller so that  $\omega_c = 10$  rad/sec, and  $PM = 50^\circ$ .



$$K(s) = K(1 + s/a)$$

Have to decide values for  $a$ ,  $k$ . To choose  $a$ , we know that we want  $PM = 50$ , but have to consider phase from poles and zeros at  $\omega_c = 10$ .

$$-180^\circ + 50^\circ = -130^\circ = \tan^{-1} \frac{\omega_c/a}{1} - 2 \tan^{-1} \frac{\omega_c}{1}$$

$$\Rightarrow a = 12.5$$

Now we need to choose  $K$ .

$$\begin{aligned} |K(j\omega_c)G(j\omega_c)| &= 1 \\ \frac{K\sqrt{1^2 + 10^2/12.5^2}}{(\sqrt{10^2 + 1^2})^2} &= 1 \end{aligned}$$

$$K = \frac{1}{0.0127}$$

$$K = 78.87$$

$$K(s) = 78.87 \left( 1 + \frac{s}{12.5} \right)$$

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